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Method and system for transmitting data.

The invention relates to a method for transmitting data from several first stations to a second station, the first stations each comprising at least a first transmitter, a first receiver and a first clock and the second station comprising at least a second transmitter, a second receiver and a second clock, the method comprising:

- transmitting, in a synchronisation time slot of a time window, a synchronisation message from the second station to the first stations,
- transmitting, in a selection time slot of the time window, selection messages from the second station to selected first stations,
- transmitting, in response time slots of the time window, data from selected first stations to the second station.

Such a method is disclosed in the American patent specification 5,297,144.

A method of the above type is applied, e.g., for transmitting data, such as measurement data, from several dispersed local stations (first stations) to a central station (second station). In doing so, the second station, which collects the data from the first stations and/or passes it on to a further station, may have the first stations transmit data by polling. The transmission may take place wirelessly by way of, e.g., a radio link, but also by way of a cable. To the data, there may be added an identification of the transmitting first station. The drawback of such a method is, firstly, that each first station must be continuously capable of receiving the call signal (selection signal) and of transmitting data. In other words: the transmitter and receiver of the first station should be permanently activated. For battery-powered first stations, however, the problem arises that as a result the battery may be exhausted relatively fast.

A method of the above type secondly has the drawback that, in supplement of the data, there should always be transmitted the identification of the transmitting first station, which requires additional transmission time and therefore additional energy.

In the above American patent specification, a method is proposed in which the first stations wait for a selection message (call message). Immediately after receiving a selection message intended for the station in question, the response time slot commences in which the first station transmits its data. In

anticipation of a next selection time slot, the other first stations should keep their receivers switched on. As a result, the first stations consume a relatively large amount of energy. In addition, for this known method, there is a reservation time slot present in
5 the time window for each first station. In the event of large numbers of first stations, this results in an unacceptably large time window.

The American patent specification US 4 466 001 also describes a system for transmitting data in which selection messages are each
10 time transmitted to the various first stations. By polling the first stations with intervals, here, too, the receivers of the first stations should be switched on for a relatively extensive period of time.

The object of the present invention is to eliminate the above
15 and other drawbacks, and to provide a method of the type referred to in the preamble, which facilitates a very efficient energy consumption of the first stations. Such a method is therefore, in accordance with the invention, characterised by transmitting, in one single selection time slot, the selection messages and the
20 deactivation, by each first station, of its receiver if no respective selection message has been transmitted.

By transmitting the selection messages in one single selection time slot, the time period during which the receivers of the first stations must be activated to collect any further selection messages,
25 is severely restricted. In the single selection time slot, each first station may verify whether there has been transmitted a selection message intended for it. If such is not the case, the first station in question may deactivate its receiver for the remainder of the time window, since there will follow no further
30 selection messages. As a result, there are attained significant savings in energy, which will significantly extend the effective operating time of the first stations, particularly battery-powered first stations.

Deactivating the receivers of the unselected first stations may
35 take place at the end of the selection time slot, e.g., at a predetermined time, or in response to a deactivation message, which may also be transmitted in the selection time slot. The selection messages are advantageously transmitted in a predetermined order, and

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deactivating takes place based on the sequence. As a result, it is possible that, prior to the end of the selection time slot, a first station may already determine, based on selection messages located earlier in the sequence, that there will be transmitted no selection message intended for it. This has the advantage that the receiver of the first station may be switched off sooner.

The sequence may be, e.g., a numeric order, a number being allotted to the first station, and the numbers being run through consecutively. There may also be applied a deviating order, stored in both the first and the second stations.

The selection messages are advantageously transmitted in a predetermined order, and deactivation takes place based on the order. By alternately using, e.g., an ascending and descending number sequence, it is prevented that specific first stations must always wait longer than other ones before their respective selection message is transmitted or not. As a result, the energy consumption of the first stations is distributed more evenly.

The selection messages may each contain a time indication of the respective response time slots. In this manner, there may be realised a suitable allocation of the available response time slots for each time window. In addition, it is achieved that for all selected first stations the response time slot in question is known no later than at the end of the selection time slot.

A flexible allocation of the response time slots may also be achieved if the selection messages each contain a time indication of command time slots following the selection time slot for transmitting command messages from the second station to the selected first station.

A command message preferably contains a time indication of a response time slot. By introducing such a form of indirection, command messages may be transmitted to the selected first stations. Since only the selected first stations need an activated receiver during the command time slots, the required amount of additional energy is minimal.

In order to achieve further energy savings, the transmitter of each first station is only activated during the respective response time slot.

Although the time window may have a fixed, predetermined

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- several first stations, each having a first transmitter, a first receiver, a first control unit and a first clock,

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FIG. 1 schematically shows a system for transmitting data, to

Figures FIG. 2A and 2B schematically show a first station and

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a fixed station, but may also be formed by, e.g., a satellite.

In FIG. 2A, a first station 1 is schematically shown in greater detail. The first station 1 comprises a transmitter 11, a receiver 12, a control apparatus 13, an antenna 14, a battery 15, a clock 16 and a measuring apparatus 17, which are mutually coupled. The measuring apparatus 17 may be provided with sensors (not shown) and a data buffer. The clock 16 may be, e.g., a clock for universal time (e.g., GMT [= Greenwich Mean Time]), or a synchronised counter.

The second station 2 schematically shown in FIG. 2B comprises a transmitter 21, a receiver 22, a processing unit 23, an antenna 24, a power supply 25 and a clock 26, which are mutually coupled. The processing unit 23, which may be formed by, e.g., a microprocessor, may serve both for processing data (e.g., measurement data transmitted from the first stations) and for controlling the second station 2.

The transmitters 11 and 21, and the receivers 12 and 22, may be commercially available components which are arranged, e.g., for wireless transmission by way of a suitable radio frequency which may also lie in a frequency band for wireless telephony (e.g., GSM [= Global System for Mobile communications]). Basically, use may be made of one frequency for both the transmitter and the receiver (half duplex), but it is also possible to use different frequencies for the transmitter and the receiver.

In the system of FIG. 1, data is to be transmitted from the first stations 1a-1d to the second station. In accordance with the invention, the second (central) station 2 unequivocally allots time slots to the first stations 1a-1d for this purpose within a time window. This will be explained in greater detail by reference to the figures FIG. 3 and 4.

30 In accordance with a first embodiment, the time window 4 schematically shown in FIG. 3 comprises four consecutive response time slots 8a, 8b, 8c and 8d, which start at the times T2, T3, T4 and T5, respectively. In the embodiment shown, each of the time slots 8a-8d is allotted to one of the first stations 1a-1d of FIG. 1.

35 Here, the order of allocation is basically random. The allocation itself takes place beforehand, in an initialisation process, the receivers of all first stations being active and the second station transmitting, e.g., an identification to each first station, as well

as the time limits (e.g., T3 and T4) of the allotted time slot in question. The initialisation process is carried out on the basis of the time slots 5 and 6. In the synchronisation time slot 5, which starts at time T0 (= start of the time window 4), the second station 2 transmits a synchronisation message SYN to all first stations. In the selection time slot 6, which starts at time T1, the second station transmits a selection message SEL to selected first stations. This will be explained in greater detail later.

In accordance with the invention, the first stations in their allotted time slots sequentially transmit data to the second station. In this connection, the first station 1a transmits, e.g., in the time slot 8a, i.e., between times T2 and T3. Subsequently, the first station 1b transmits in time slot 8b, etc. In this manner, the transmitter (11) of the first station 1a need be active and consume energy only between times T0 and T1, since said transmitter may be switched off at time T1. Possibly, the transmitter may be switched off earlier if the end of the data to be transmitted is reached prior to the end of the time slot. If the first station in question need not transmit any data, it is possible for the transmitter not to be switched on at all. Periodically, however, the transmitter may be activated to report the correct functioning of the first station.

In accordance with the invention, the receivers (12) of the first stations may be switched off during or after the selection time slot 6, i.e., no later than time T2. This will be explained in greater detail later.

Preferably, the time window 4 is cyclically repeated, the time slot 5 of the next time window following the time slot 8d (T6=T0'). As a result, in the exemplary embodiment shown in FIG. 3 each first station permanently has at its disposal one-fourth part of the response time slots 8 of the time window 4 for transmitting data, so that each transmitter is inactive for more than three-quarters of the duration of time window 4. The receivers of the first stations are preferably switched off during the response time slots 8.

At the start of the time window 4, a synchronisation message SYN and a selection message SEL are transmitted. On the basis of the synchronisation message SYN, the first clocks 16 are synchronised with the second clock 26; see figures FIG. 2A and 2B. For this purpose, in each time window the receivers of the first stations are

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In response to the selection or request message (SEL), the first station in question transmits data to the second station in the response time slot allotted to it.

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5 The first identification ("address") ID containing a command
message COM may include a subaddress indicating a part (e.g., a
connected measuring apparatus) of the first station, and/or a
superaddress indicating several first stations. In the latter case,
a supplementary address may be transmitted to a first station,
10 enabling a separate identification within the group indicated by the
superaddress.

It will be understood that in this embodiment, too, energy is saved in the first stations, since the transmitters and/or receivers
20 of the first stations may be inactive most of the time.

Although in the above embodiments it was assumed that in each time window 4 a response time slot 8 is allotted to all first stations, such need not be the case at all and the second station (in a specific time window) may allot a response time slot only to one or a few first stations. Possibly, the first stations, which are not selected in a specific time window, may have their turn in a subsequent time window.

A major advantage of the present invention is the fact that the number of first stations is substantially unlimited. By adaptively allotting, in each time window, time slots to first stations, it is possible, with a single second station, to transmit data from a substantially arbitrary number of first stations.

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